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EXAMINER	
CAO, PHAT X	

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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/663,948
Filing Date: September 16, 2003
Appellant(s): TIWARI ET AL.

Thomas G. Eschweiler
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 5/15/06 appealing from the Office action mailed 9/9/2005.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

US 2003/0227089 WATANABE ET AL. 12-2003

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. Claims 1-2, 4 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shimizu (US. 6,433,432) in view of Watanabe et al (US. 2003/0227089).

Regarding claims 1 and 2, Shimizu (Figs. 3H-3K) discloses a method of forming a copper interconnect layer, comprising: forming a first copper region 10 (column 4, lines 54-56) over a semiconductor substrate 1; forming a low K dielectric layer 12 (column 5, lines 27-30 and column 1, lines 16-21) over the copper region 10; forming a plurality of vias 12a in a first region of the low K dielectric layer 12; forming a trench 16 with a first edge 13 in the low K dielectric layer 12 over the plurality of vias, wherein the trench 16 extends a minimum length 12b beyond the edge of a via 12a closest to the first edge of the trench; and filling the trench 16 and the plurality of vias with copper 14 (column 5, lines 60-62). Shimizu's Fig. 3J further discloses that the trench 16 is formed with a first depth d1 in the first region and a second depth d2 at the trench edge 12b when d1 is greater than d2 (see Figs. 3H - 3J below).

FIG. 3H

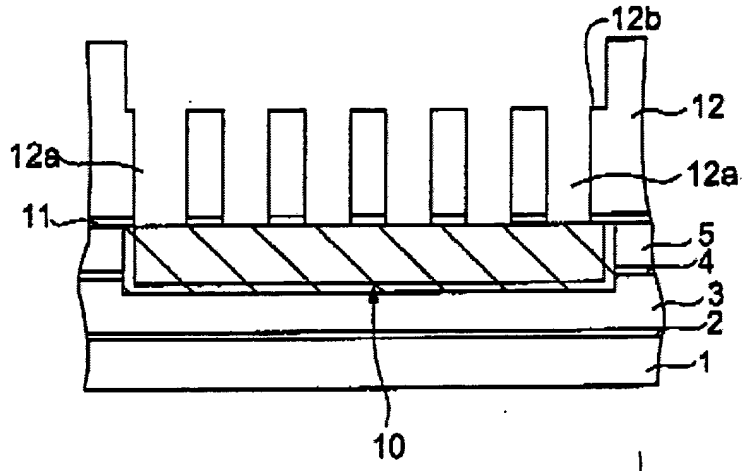

12b
12
12a
12a
11
5
4
3
2
1
10

FIG. 3I

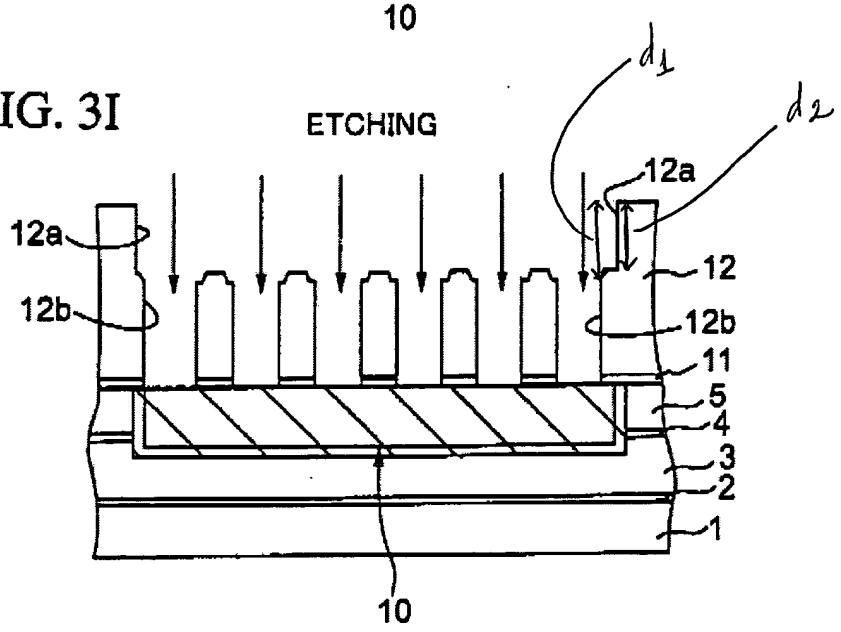
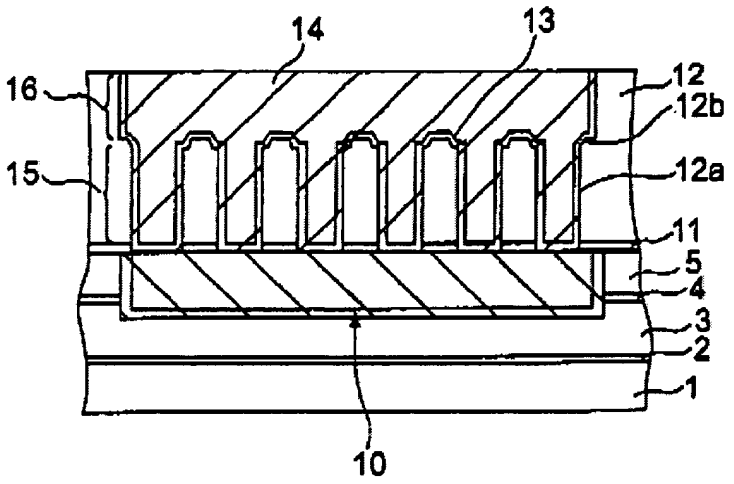

ETCHING
d_1
d_2
12a
12a
12
12b
12b
11
5
4
3
2
1
10

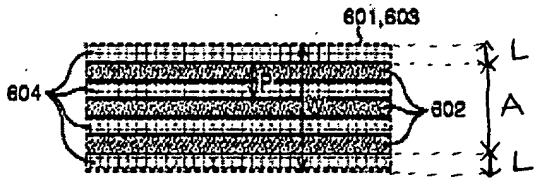
FIG. 3J



Shimizu does not disclose that the minimum length 12b extending beyond the edge of the via 12a is 0.2 um.

However, Shimizu does disclose that the trench 16 extends a minimum length 12b beyond the edge of the via 12a closest to the first edge of the trench 16 (Fig. 3J), the edges of the via 12a are obliquely scraped off to expand a diameter of the via 12a in the neighborhood of the trench 16 (column 5, lines 45-51) for participating in preventing the peeling-off of the plugs from the metal wirings (column 6, lines 13-19). Furthermore, Watanabe (Figs. 24B-24C) teaches a forming of a copper interconnect structure comprising a trench 603 formed over a plurality of vias 602. The pitch of the via patterns 602 is 0.6 um, the width of the via pattern 602 is 0.3 um, and the width of the wiring trench 603 is 10 um (par. [0175]). Therefore, the trench 603 extends a length of 4.25 um beyond the edge of the via 602 (see Figs. 24b-24c and the calculation below).

FIG. 24B



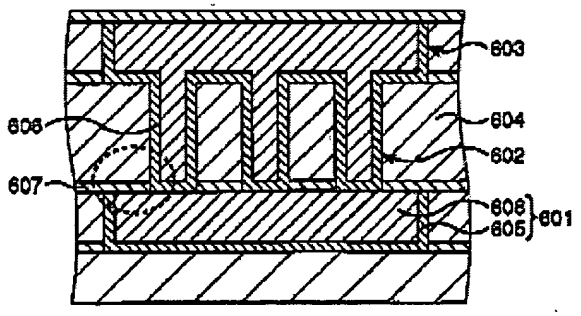
P(PITCH) = 0.6 μm
W(trench) = 10μm
W(vias) = 0.3 μm

A = 2P + W(vias)
=(2 X 0.6) + 0.3 = 1.5 μm

2L = W(trench) − A
= 10 − 1.5 = 8.5 μm

L = 8.5/2 = 4.25 μm

FIG. 24C



Accordingly, it would have been obvious to extend the length 12b of the trench beyond the edge of the via 12a closest to the first edge of the trench with a minimum length as claimed (as suggested by Watanabe) because such minimum length would provide the same effects of preventing the peeling-off of the plugs from the metal wiring.

Regarding claims 4 and 9, as discussed in details above, the combination of Shimizu and Watanabe substantially reads on the invention as claimed. Watanabe (Figs. 24B-24C) further teaches that the plurality of vias 602 are separated by a distance of 0.6 um (par. [0175]). Accordingly, it would have been obvious to separate the plurality of vias of Shimizu with a distance as set forth above because such distance is not critical, it can be adjusted depending upon the width desired for the wiring patterns, as taught by Watanabe (par. [0175]).

(10) Response to Argument

A) Appellant (pages 3-4 of Brief) argues that Shimizu fails to disclose a trench extending a minimum length of 0.2 um beyond the edge of a via closest to the first edge of the trench as claimed.

This argument is not persuasive because of the following reasons:

First, this argument has no immediately apparent relevance to the issues presented by the rejection since Appellant cannot show nonobviousness by attacking references individually where the rejection is based upon a combination of references. *In re Young*, 403 F. 2d 754, 757, 159 USPQ 725, 728 (CCPA 1968). It should be noted that the rejection is not based on anticipation, but rather, is based on obviousness. The examiner relies on the combined teachings of Shimizu and Watanabe. Shimizu is not relied on for teaching a trench extending a minimum length of 0.2 um beyond the edge of a via closest to the first edge of the trench. Watanabe discloses a trench 603 extending a minimum length of 0.2 um (i.e., 4.25 um) beyond the edge of a via 602 closest to the first edge of the trench 603 (see ground of rejection for more details). Shimizu is relied on for showing that it was known to form a trench 16 over a plurality of vias 12a (see Figs. 3H-3J), the trench 16 extending a minimum length of 12b (see Fig. 3H) beyond the edge of the via 12a closest to the first edge of the trench 16. The examiner thus regards Appellant's assertions as constituting evidence that Appellant has failed to consider as a whole the prior art teachings disclosed by the combining of the references. And

Second, it should be noted that "the law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims ... In such a situation, the Applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." *In re Woodruff*, 919 FR. 2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990). In this case, there is nothing in Appellant's disclosure, which supports that the trench extension overhang of minimum length of 0.2 um beyond the edge of a via is critical. Therefore, Appellant fails to show that the particular range of the trench extension as claimed is critical and fails to show that the claimed range achieves unexpected results.

B) Appellant (pages 4-5 of Brief) also argues that the trench extension 12b of the trench 16 beyond the edge of a via 12a (see Fig. 3H of Shimizu) does not participate in preventing the peeling-off of the plugs from the metal wiring.

This argument is not persuasive because of the following reasons:

First, Shimizu clearly discloses a process of fabricating the metal plugs (Figs. 3A-3K), which are not lifted from the metal wiring (column 2, lines 31-42). The process includes the step of removing the oxide film formed on the surface of the copper wiring 10 and the step of obliquely scraping off the edge of the via 12a "to expand a diameter of the holes 12a in the neighborhood of the pad trench 12b" (see Fig. 3I and column 5, lines 45-51). Therefore, the step of removing the oxide film formed on the surface of the copper wiring 10 for cleaning the surface of the copper wiring 10 and the step of obliquely scraping off the edge of the via 12a for expanding a diameter of the vias 12a

in the neighborhood of the trench extension 12b would improve the adhesiveness between the insulating film and the metal wiring and would prevent the peeling-off of the vias 12a from the metal wiring 10. And

Second, it is noted that when the structure recited in the reference is substantially identical to that of the claims, claimed properties or functions are presumed to be inherent. *In re Best*, 195 USPQ 430, 433 (CCPA 1977). In this case, as asserted by Appellant, the peeling-off of the plugs from the metal wirings results from the trench termination overhang Xto (see Appellant's Fig. 2C), the trench termination overhang Xto includes a first trench depth d1 and a second trench depth d2, the first trench depth d1 is greater than the second trench depth d2 (d1>d2) (pages 7-8 of Appellant's specification). Similarly, Shimizu also discloses a copper interconnect structure having a trench termination overhang 12b (Fig. 3I), the trench termination overhang 12b includes a first trench depth d1 and a second trench depth d2 (see Fig. 3J below), the first trench depth d1 is greater than the second trench depth d2 (d1>d2). Therefore, because the trench termination overhang of Appellant is not different from the trench termination overhang of Shimizu, the trench termination overhang 12b of Shimizu would have the same properties of preventing the peeling-off of the plugs from the metal wirings.

FIG. 3I

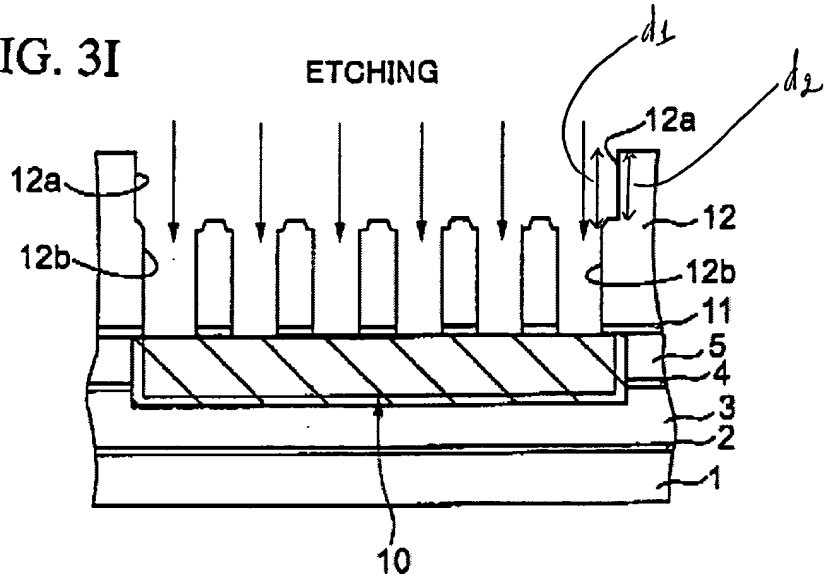
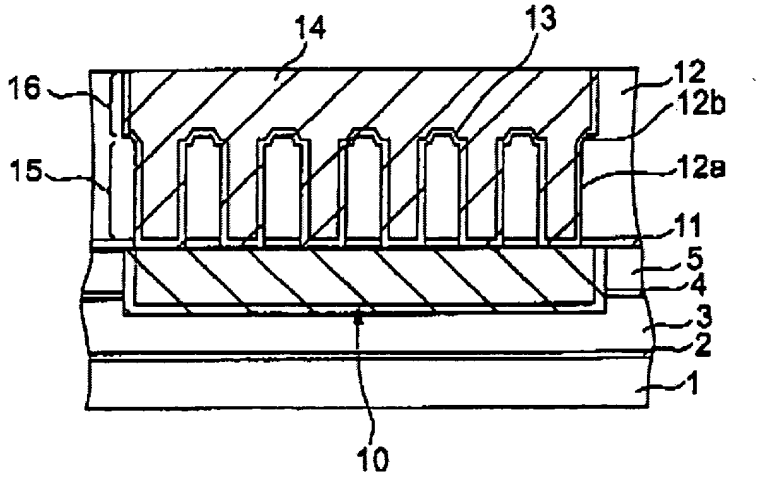


FIG. 3J



It is further noted that "when the PTO shows a sound basis for believing that the products of the applicant and the prior art are the same, the applicant has the burden of showing that they are not." *In re Spada*, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990). In this case, Appellant fails to provide the reasons to support that why the trench termination overhang 12b of Shimizu would not have the same properties of preventing the peeling-off of the plugs from the metal wirings even though the trench termination

overhang 12b of Shimizu also has the first trench depth d1 being greater than the second depth d2.

C) Appellant (page 6 of Brief) argues that Watanabe does not teach or suggest a minimum length between a via edge and a trench edge in a range as claimed.

This argument is not persuasive because Watanabe (Figs. 24b-24c) clearly teaches the forming of a copper interconnect structure comprising a trench 603 formed over a plurality of vias 602, the trench 603 extends a length of 4.25 um beyond the edge of the via 602 closest to the first edge of the trench. Specifically, Watanabe discloses that "it is assumed that the width W of the wiring patterns ... 603 is 10 um, and pitch P of the via patterns 602 is 0.6 um. Further assuming that the width of the via pattern 602 is 0.3 um ..." (par. [0175]). Accordingly, the distance A between the three via patterns 602 would be equal 1.5 um and the length L between a via edge and a trench edge would be equal to 4.25 um ((10 um – 1.5 um)/2) (see Figs. 24B-24C and the calculation below).

FIG. 24B

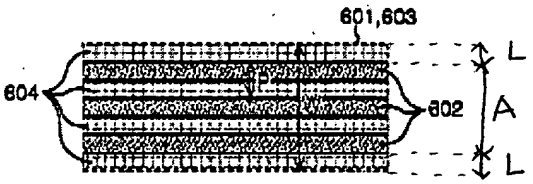
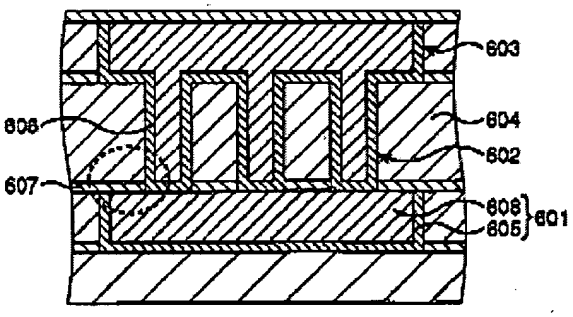


FIG. 24C



P(PITCH) = 0.6 μm
W(trench) = 10 μm
W(vias) = 0.3 μm

A = 2P + W(vias)
= (2 × 0.6) + 0.3 = 1.5 μm

2L = W(trench) − A
= 10 − 1.5 = 8.5 μm

L = 8.5/2 = 4.25 μm

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

PC

July 20, 2006

Conferees:

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Supervisory Patent Examiner

Phat X. Cao
Primary Examiner PC